

Claims

1. A method for locating a mobile station comprising  
5 the steps of  
    using fixed transmitting stations (BS1, BS2, BS3)  
    for positioning a target mobile station (MS1) by  
    transmitting a measurement signal from each fixed  
    transmitting station to said mobile station,  
10      using a relay station (MSN1 - MSN5) which is adapted  
    to receive said measurement signal from the corresponding  
    fixed transmitting station and to forward said signal to  
    said target mobile station (MS1), in case a direct  
15      transmission from one or more of said fixed transmitting  
    stations (BS1, BS2, BS3) is not available,  
    determining the distance between said target mobile  
    station (MS1) to the fixed transmitting stations and/or  
    the relay stations on the basis of said measurement  
20      signal, and  
    locating the position of said target mobile station  
    on the basis of the determined distances.

2. The method according to claim 1, wherein said relay  
station (MSN1 - MSN5) is a movable mobile station.

3. The method according to claim 2, wherein a distance  
D (D1, D2, D3) between said relay station and said target  
mobile station is calculated based on the following  
equation:

$$D = c\Delta t + \beta d_{\max},$$

wherein  $c$  is the light velocity,  $\Delta t$  is the  
propagation delay of the measurement signal,  $\beta$  is in a

range from -1 to +1, and  $d_{max}$  is the maximum distance by which the relay station can move during  $\Delta t$ .

4. The method according to claim 3, wherein said  
5 distance  $d_{max}$  is determined by the following equation:

$$d_{max} = v_{max}\Delta t + e,$$

10 wherein  $v_{max}$  is the maximum velocity of the relay station and  $e$  is a measurement error.

5. The method according to claim 1, comprising the step of judging whether a request for a location of said target mobile station is authorized or not.

- 15 6. The method according to claim 5, wherein for said judging step subscriber data of a data base (HLR) are used.

- 20 7. The method according to claim 1, comprising the step of synchronizing said base stations and said mobile stations involved in the positioning before performing said locating step.

- 25 8. The method according to any one of the previous claims, wherein the calculation of the location of said target mobile station is performed on the basis of any positioning method based on radio wave propagation data.

- 30 9. The method according to claim 8, wherein said positioning method based on radio wave propagation data is one of TDOA, TOA or TA.

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10. The method according to any one of the previous claims, wherein said method is carried out in a WCDMA network.

5 11. The method according to any one of the previous claims, wherein each positioning request is provided with a priority level and in case of a plurality of simultaneous positioning request, the positioning requests are processed in dependence on the priority  
10 level.

12. A radio network, comprising  
transmitting stations (BS1, BS2, BS3) which are adapted for positioning a target mobile station (MS1) by  
15 transmitting a measurement signal from each fixed transmitting station to said mobile station,

at least one relay station (MSN1 - MSN5) which is adapted to receive said measurement signal from the corresponding fixed transmitting station and to forward  
20 said signal to said target mobile station (MS1), in case a direct transmission said fixed transmitting stations (BS1, BS2, BS3) is not available, and

a means which is adapted to determine the distance between said target mobile station (MS1) to the fixed  
25 transmitting stations and/or the relay stations on the basis of said measurement signal, and

which is adapted to locate the position of said target mobile station on the basis of the determined distances.

30 13. The radio network according to claim 12, wherein said determination and location means is a mobile location center (GMLC).

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14. The radio network according to claim 12 or 13, , wherein said relay station (**MSN1** - **MSN5**) is a movable mobile station.

5 15. The radio network according to claim 14, wherein a said determination means calculates said distance D (**D1**, **D2**, **D3**) between said relay station and said target mobile station based on the following equation:

10 
$$D = c\Delta t + \beta d_{\max},$$

wherein c is the light velocity,  $\Delta t$  is the propagation delay of the measurement signal,  $\beta$  is in a range from -1 to +1, and  $d_{\max}$  is the maximum distance by which the relay station can move during  $\Delta t$ .

16. The radio network according to claim 15, wherein said distance  $d_{\max}$  is determined by the following equation:

20 
$$d_{\max} = v_{\max}\Delta t + e,$$

wherein  $v_{\max}$  is the maximum velocity of the relay station and e is a measurement error.

25 17. The radio network according to claim 13, wherein said mobile location center (**GMLC**) is further adapted to judge whether a request for a location of said target mobile station is authorized or not.

30 18. The radio network according to claim 17, wherein said mobile location center (**GMLC**) is adapted to use subscriber data of a data base (**HLR**) are used.

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19. The radio network according to any one of the claims 12 to 18, wherein said radio network is a WCDMA network.

20. The radio network according to any one of the claims 12 to 19, wherein each positioning request is provided with a priority level and in case of a plurality of simultaneous positioning request, said mobile location center (GMLC) is adapted to process the positioning requests in dependence on the priority level.

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